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(54) "SPRAYING OF CURABLE ADHESIVES"

(71) We, AB CASCO, a Swedish Body Corporate, of Box 11 010, 100 61 Stockholm 11, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to the spraying of curable adhesive compositions onto wooden surfaces to be jointed.

Curable adhesives have found wide application in the jointing of wood and in the bonding of wooden constructions. In recent years the so-called finger jointing method has often been employed for the longitudinal jointing of timber. A fast curing glue is necessary in such systems so that the jointed timber article may be handled shortly after the jointing operation. By preheating the timber ends to be joined in e.g. a radio frequency field (high frequency electrical field) and at the same time employing resorcinol glues or phenol-resorcinol glues, this technique has gained industrial application. The glue is applied onto the finger shaped ends by means of pressure extrusion of two glue components, i.e., the liquid resin and a liquid hardener (curing agent) are sprayed separately instead of applying a mixture of hardener in pulverulous form and a liquid resin as hitherto done. When spraying the resin and the liquid hardener separately the two streams are allowed to meet just before they hit the surface to be treated thus eliminating the risk of hardening in the spray nozzle.

Apart from finger jointing the same method can be applied to the bonding of flat surfaces e.g. lamination in the manufacture of laminated beams (laminated wood).

To enable spraying of the resin component at room temperature the dry content must be limited to about 60%. In order to enable spraying of the hardener component, the hardener must be employed in liquid form. Consequently, the dry content of the hardener-resin mixture will be low and thus the filling properties of the glue-hardener composition are impaired. To improve the filling properties of the curable adhesive formulation when using a liquid hardener it is therefore desired to spray a resin solution having a higher resin content.

Thus, according to the present invention there is provided a method of spraying a curable adhesive onto a wooden surface which comprises spraying onto a wooden surface a liquid formaldehyde resin composition and a liquid hardener composition for the resin the resin composition and hardener composition being sprayed separately onto the surface in either order or simultaneously and the resin solution having a dry content of more than 65%, preferably 70-75%, and being sprayed at a temperature of at least 40°C, preferably 40-80°C.

In a further aspect the invention also relates to a method of joining two wooden surfaces which comprises spraying a curable adhesive onto each jointing surface by a method according to the invention as defined above, followed by holding the sprayed surfaces in contact with one another under pressure.

Preferably the resin and hardener compositions are simultaneously sprayed onto the surface from separate nozzles. It is however possible for the resin and hardener compositions to be sprayed in either order, i.e., the resin sprayed first, followed by the hardener, or vice versa.

The heating of curable resins has been avoided in the past because the pre-condensate glue has a tendency to polymerise (condense) further so that the spreading properties of the adhesive in the sprayer and on the (straight-glued) joints become less good or are even inhibited. These problems are accentuated even more the higher the temperature.

We have found that it is possible to spray resins having a dry content exceeding 65% when the resin solution is heated to at least 40°C. Tests carried out with phenol-resorcinol glues in an alcoholic aqueous solution having various dry contents have shown that the viscosity at a

temperature of 40°C is decreased to such an extent that sprayability is achieved. By spraying the resin component in a moderately heated condition it is possible to use resin solutions having a higher resin content which essentially improves the strength of the bond.

The results from our measurements are shown in the accompanying Figure 1. Figure 1 is a curve of viscosity (Brookfield, spindle 4, velocity 60 rpm) against temperature for a formaldehyde/phenol/resorcinol resin at differing dry contents. Each curve represents a different dry content as follows:

Curve A – dry content 59.1%
B – dry content 65.1%
C – dry content 70.1%
D – dry content 72.1%
E – dry content 74.4%

Our tests have revealed that spraying the resin at a temperature of 20°C or more *above* room temperature (at least 40°C) gives the desired results.

Another advantage of the present invention is that the adhesive (resin-hardener mixture) bonds more rapidly.

A further advantage of the present invention is that an improved strength is generally obtained when bonding wood having a high moisture content. Other curable resins, such as melamine formaldehyde resin and acetone formaldehyde resin may be used in the same way as formaldehyde/phenol/resorcinol resin when bonding. Preferred resins are however formaldehyde/resorcinol, formaldehyde/resorcinol/phenol, and formaldehyde/phenol resins. Preferably the molar ratio of formaldehyde to resorcinol in the formaldehyde/resorcinol resin, and the ratio of formaldehyde to resorcinol+phenol in the formaldehyde resorcinol/resin, is from 0.5 to 0.8. Preferably in the latter resin the molar ratio of resorcinol:phenol is about 1:1. Preferably the hardener is an aqueous aldehyde solution, e.g. aqueous formaldehyde. The formaldehyde may constitute about 40% by weight of the aqueous solution. A thickener may also be present in the aldehyde solution. The thickener may be a water-swellable starch, preferably used in amounts of 4-5% by weight. The method of the invention is generally applicable to all kinds of wood. In the finger jointing of wood in saw mills the moisture content of the wood used is frequently high which is the reason why the jointing strength is often poor. The present invention minimises this problem, deriving from the use of moist wood, by means of the higher dry content of the resin. When bonding by the method of the present invention improved joint strength may be obtained.

The invention will now be further described with reference to Figure 2 of the accompanying drawings, which is a diagrammatic view of an apparatus suitable for carrying out the process of the invention.

Referring to Figure 2, a stroage tank 1 for the resin solution is connected via a line 10 to a pump 3, which in turn is connected to a resin spray nozzle 6 via a line 11. An electrical heater 5 maintains the resin at the required temperature of at least 40°C. A storage tank 2 for the resin hardener is connected via line 12 to a pump 4, which in turn is connected via a line 13 to a hardener spray nozzle 7. A resin solution return line 9 connects spray nozzle 6 and pump 3.

In operation, resin solution is initially pumped by pump 3 from storage tank 1 to the nozzle 6, and back through return line 9 to pump 3, so as to heat the resin to the required temperature. When the required temperature has been reached, spraying of the resin is commenced. Resin hardener is pumped by pump 4 to nozzle 7. Heater 5 maintains the resin solution during the spraying operation at such a temperature that it is sprayed at a temperature of at least 40°C. A finger joint 14 of a piece of wood 8 is simultaneously sprayed with the resin from nozzle 6 and the hardener from nozzle 8. As shown in the Figure, the two streams impinge and admix before striking the wooden surface. It is however not essential for the streams to impinge before striking the joint surface 14. The piece of wood 8 is moved transversally across the front of the nozzles 6 and 7 in the direction of the arrow A so that the whole length of the joint surface 14 is sprayed.

WHAT WE CLAIM IS:–

1. A method of applying a curable adhesive composition to a wooden surface which comprises spraying onto a wooden surface a liquid formaldehyde resin composition and a liquid hardener composition for the resin, the resin composition and the hardener composition being sprayed separately onto the surface in either order or simultaneously and the resin composition having a dry content of more than 65% and being sprayed at a temperature of at least 40°C.

2. A method as claimed in claim 1, wherein the resin composition is a solution having a dry content of 70-75%, the solution being sprayed at a temperature of 40-80%.

3. A method as claimed in either of claims 1 or 2, wherein the resin composition is an aqueous solution of a precondensate of formaldehyde with either phenol, resorcinol, or a mixture thereof.

4. A method as claimed in claim 3, wherein the resin composition is a formaldehyde/resorcinol resin wherein the molar ratio of formaldehyde:resorcinol is from 0.5 to 0.8.

5. A method as claimed in claim 3 wherein the resin composition is a pre-condensate of formaldehyde with a mixture of resorcinol and phenol wherein the molar ratio of formaldehyde to the resorcinol+phenol is from 0.5 to 0.8.

6. A method as claimed in claim 5, wherein the molar ratio of resorcinol/phenol is about 1:1.

7. A method as claimed in any one of the

preceding claims wherein the hardener composition is an aqueous solution containing an aldehyde.

8. A method as claimed in claim 7, wherein the aldehyde is formaldehyde.

9. A method as claimed in claim 7 or 8, wherein the hardener solution includes a thickening agent.

10. A method as claimed in claim 9, wherein the thickener is starch.

11. A method as claimed in any one of the preceding claims, wherein the resin composition and hardener composition are simultaneously sprayed from separate nozzles in the forms of streams which meet and admix after leaving the nozzles but before contacting the surface.

12. A method as claimed in any one of the preceding claims, wherein the surface is moved transversally in front of the nozzles.

13. A method as claimed in claim 1 substantially as specifically described herein.

14. A method as claimed in claim 1 substantially as hereinbefore described with refer ence to Figure 2 of the accompanying drawings..

15. An article having a wooden surface which has been sprayed by a method as claimed in any one of the preceding claims.

16. A method of joining two wooden surfaces which comprises spraying a curable adhesive onto each jointing surface by a method claimed in any one of claims 1 to 14, followed by holding the sprayed surfaces in contact with one another under pressure.

17. An article having two wooden surfaces which have been joined together by a method as claimed in claim 16.

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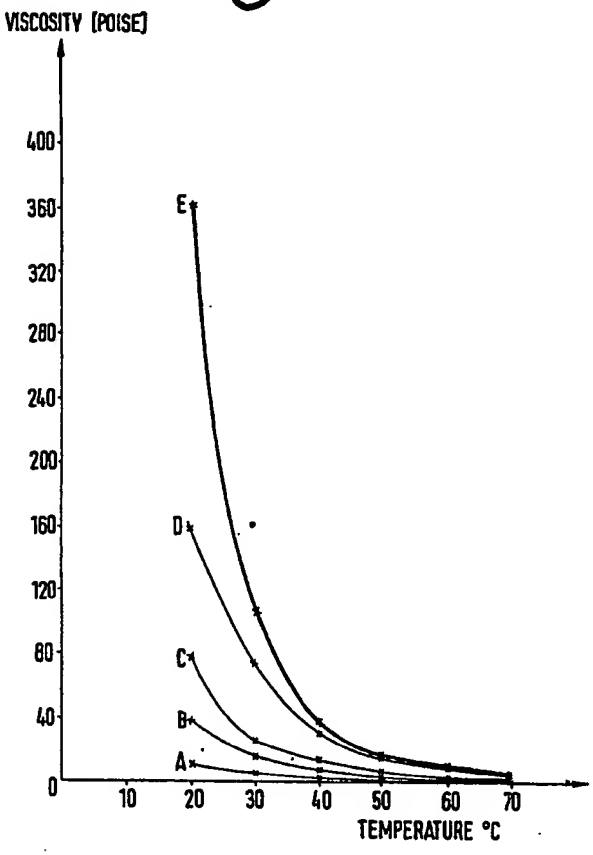
Fig. 1.



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Sheet 2

Fig.2.